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Epitome

(57) [Abstract]
[Technical problem] The brake system which power consumption is small as much as possible, and ends is obtained.
[Means for Solution] When the boost inclination demanded by treading in of a brake pedal is smaller than setting inclination (S4 is NO), only small high pressure pumping of drive power is operated (S5), and when larger than setting inclination (S4 is YES), both (S13) or a low voltage pump, and high pressure pumping (S13 and S15) are operated only for a low voltage pump. Moreover, when the treading strength of a brake pedal is small (S7 is NO), only the electromagnetic-control valve for a boost of a front-wheel brake is opened (S10 and S12), and when treading strength is large (S7 is YES), the electromagnetic-control valve for a boost of both a front-wheel brake and a rear wheel brake is opened (S9 and S10). Furthermore, the electromagnetic-control valve for a boost is opened by the opening corresponding to demand boost inclination rather than is fully opened at the time of a boost (S9 or S10).

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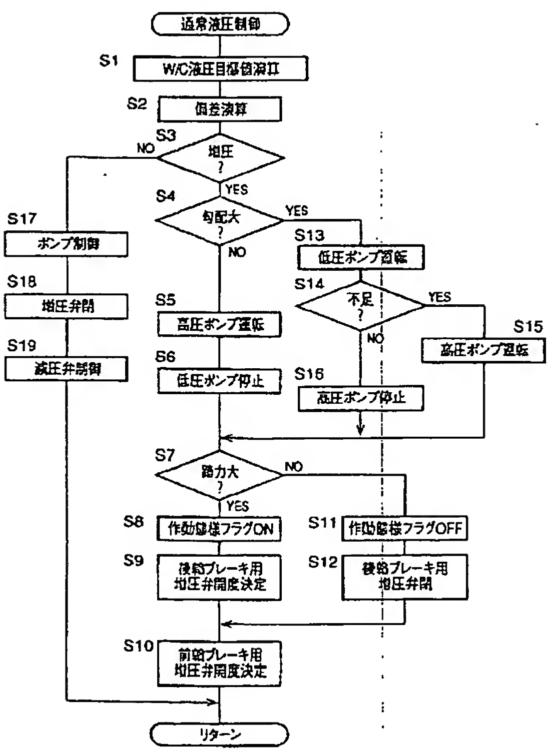

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* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] the voice of these plurality making [and] the braking effects [control device / said / damping force] characterized by providing the following corresponding [on the brake system and] to the control input of said brakes operation member into what can be generated in two or more modes -- the brake system characterized by forming the electric power supply control device which chooses the mode with which the supply voltage to a damping force control device is small, and can be managed while like, and performs the electric power supply to a damping force control device Brakes operation member At least one brake The damping force control unit which operates with power and controls the damping force of said at least one brake according to actuation of said brakes operation member

[Claim 2] The brake system according to claim 1 characterized by providing the following The rear wheel brake with which the brake system concerned controls rotation of the front-wheel brake and rear wheel which control rotation of the front wheel of a car The alternative power feed zone by which power is supplied to one side of a front-wheel damping force control device and a rear wheel damping force control device, and it supplies power including the rear wheel damping force control device which controls the damping force of the front-wheel damping force control device which controls the damping force of a front-wheel brake, and a rear wheel brake to both a front-wheel damping force control device and a rear wheel damping force control device when demand braking effects are large when said demand braking effects of said electric power supply control device are small

[Claim 3] It is the hydraulic brake to which at least one side of said front-wheel brake and rear wheel brake operates by fluid pressure. The thing corresponding to a hydraulic brake among said front-wheel damping force control device and a rear wheel damping force control device Two or more pumps with which drive power differs mutually are included. Said electric power supply control unit The brake system according to claim 1 or 2 characterized by including the alternative pump mechanical component which determines what supplies drive power among said two or more pumps at least based on one side of the magnitude of damping force and the increase inclination which are demanded by actuation of said brakes operation member.

[Claim 4] The brake system of claim 1 thru/or any one publication of three characterized by providing the following Pumping plant adjustable [thing / corresponding to / at least one side of said front-wheel brake and rear wheel brake is the hydraulic brake which operates by fluid pressure, and / a hydraulic brake among said front-wheel damping force control device and rear wheel damping force control devices] in the amount of discharge flow The power allocation control section by which said electric power supply control unit controls allocation of the supply voltage to pumping plant and boost control valve equipment including the boost control valve equipment which controls a boost of a hydraulic brake by controlling the inflow to said hydraulic brake of the brake fluid breathed out from the pumping plant so that the sum of the supply voltage to said pumping plant and boost control valve equipment becomes small

[Claim 5] The brake system characterized by forming the electric power supply control unit which controls the electric power supply to two or more damping force control units so that the sum of the supply voltage to said two or more damping force control units becomes small within limits from which the braking effects which are characterized by providing the following, and which are demanded by actuation of said brakes operation member in a brake system are obtained Brakes operation member At least one brake Two or more damping force control units which operate with power and control the damping force of said at least one brake according to actuation of said brakes operation member

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to reduction of the power consumption in a brake system.
[0002]
[Description of the Prior Art] it is indicated by JP,10-100884,A, JP,9-109862,A, etc. in the brake system -- as -- a brakes operation member, at least one brake, and power -- operating -- actuation of a brakes operation member -- responding -- the above -- even if few, there is a thing containing the damping force control unit which controls the damping force of one brake. moreover, the above -- what controls the damping force of one brake by two or more damping force control units even if few -- it is. In this kind of brake system, the interest was not conventionally paid specially to reduction of the power consumed for control of a brake. However, although the energy consumed for the drive of equipment is large of course, since energy considerable also for braking is required, the interest should also be paid to reduction of the power consumed for brake control. Especially, also when a brake system is an object for automobiles, and a dc-battery and an AC dynamo are miniaturized, reduction of power is an important problem and is much more important in the electric vehicle driven with an electric motor, and the hybrid car driven with both an electric motor and an engine.
[0003]
[Object of the Invention, a technical-problem solution means, and effectiveness] This invention makes the above situation a background, it makes as a technical problem obtaining the brake system which there is little consumption of power and ends, and the brake system of following each mode is obtained by this invention. Like a claim, each mode is classified into a term, gives a number to each item, and indicates it in the format of quoting the number of other terms if needed. This is for making an understanding of this invention easy to the last, and technical features and those combination given in this specification should not be interpreted as being limited to each following item at the thing of a publication.
(1) In the brake system containing a brakes operation member, at least one brake, and the damping force control device that operates with power and controls the damping force of said at least one brake according to actuation of said brakes operation member The braking effects [control device / said / damping force] according to the control input of said brakes operation member are made into what can be generated in two or more modes. and the voice of these plurality -- the brake system (claim 1) characterized by forming the electric power supply control unit which chooses the mode with which the supply voltage to a damping force control unit is small, and can be managed while like, and performs the electric power supply to a damping force control unit. The dynamo-electric brake to which the hydraulic brake which operates by fluid pressure also operates with electric actuators, such as an electric motor, is sufficient as a brake. When a brake is a hydraulic brake, a damping force control unit turns into a fluid pressure control unit, and an electric power supply control unit turns into equipment which controls the electric power supply to a fluid pressure damping device. When a brake is a dynamo-electric brake, an electric actuator control unit serves both as a damping force control unit and an electric power supply control unit in many cases. anyway, a damping force control device makes what can be generated in two or more modes the same braking effects demanded by braking actuation of a brakes operation member -- having -- the voice of these plurality [control device / electric

power supply] -- the mode in which a supply voltage is small and can be managed with inside [like] -- choosing -- the selection voice -- it shall respond like and power shall be supplied Follow, for example, one pump is formed to a hydraulic brake. The drive current of a pump is controlled according to the control input (an operating physical force and actuation stroke) of a brakes operation member. The regurgitation fluid pressure of a pump is controlled by it. The brake system of only the damping force of a hydraulic brake being controlled, According to the control input of a brakes operation member, the supply current to the electric actuator of a dynamo-electric brake is controlled. Like the brake system of only the damping force of a dynamo-electric brake being controlled The brake system which can generate one braking effects only in one mode does not hit the brake system concerning this invention. In addition, the damping force control unit into which an actuation situation can be changed continuously presupposes that braking effects are regarded as what can be generated in many modes to infinity.
(2) The rear wheel brake with which the brake system concerned controls rotation of the front-wheel brake and rear wheel which control rotation of the front wheel of a car, The rear wheel damping force control device which controls the damping force of the front-wheel damping force control device which controls the damping force of a front-wheel brake, and a rear wheel brake is included. When said demand braking effects of said electric power supply control unit are small The alternative power feed zone which supplies power to one side of a front-wheel damping force control unit and a rear wheel damping force control unit, and supplies power to both a front-wheel damping force control unit and a rear wheel damping force control unit when demand braking effects are large is included. Brake system given in (1) term (claim 2). In the brake system for cars equipped with the front-wheel brake and the rear wheel brake, if the deceleration is comparatively small when a car needs to be decelerated, even if it operates only either of a front-wheel brake and a rear wheel brake, required deceleration can be generated. Of course, although it is also possible to operate both a front-wheel brake and a rear wheel brake, and to acquire required deceleration, usually as compared with the case where operate only one side in that case and the same deceleration is acquired, power consumption becomes large. Therefore, in for example, below setting braking effects, only either of a front-wheel brake and a rear wheel brake is operated, and demand braking effects, such as demand deceleration and demand damping force, can secure required braking effects, reducing operating a front-wheel brake and a rear wheel brake, then power consumption, when [both] larger than setting braking effects. Especially, what is necessary is just to generate comparatively small deceleration in the brake system for automobiles in many cases, and in order for what is necessary to be just to operate only either of a front-wheel brake and a rear wheel brake when it is many, the big power reduction effectiveness is acquired. Since reduction of power consumption is especially called for strongly when automobiles are the electric vehicle driven with an electric motor, and a hybrid car driven with both an electric motor and an engine, especially this invention is effective. In addition, although it is also possible to make it brakes of the always regular one, such as a brake of the wheel of the side to which regenerative braking is not performed when only either of a front-wheel brake and a rear wheel brake is operated, operated It is also possible to make it a front-wheel brake and a rear wheel brake operated almost equally by to establish an actuation brake decision means to determine the brake to operate automatically based on the regulation which was able to be defined beforehand etc.
(3) When said demand braking effects of said alternative power feed zone are small, it supplies power to a front-wheel damping force control unit, and does not supply power to a rear wheel damping force control unit. Brake system given in (2) terms. Since the load migration by the side of a front wheel occurs with braking, generally braking effects with the bigger front-wheel brake than a rear wheel brake may be produced. Therefore, if a front-wheel brake is chosen when operating one brake, in many cases, it is not necessary to operate a rear wheel brake.
(4) It is the hydraulic brake with which said front-wheel brake and a rear wheel brake both operate based on the fluid pressure of the source of power fluid pressure, and the reducing valve for [that said front-wheel damping force control device and a rear wheel damping force control device contain the boost bulb which increases the fluid pressure of a front-wheel brake and a rear wheel brake respectively, and the reducing valve to decrease] rear wheel brakes is a normally open valve. Brake system given in (3) terms. Although it becomes easy about the reducing valve for rear wheel brakes to cancel the residual pressure of the source of power fluid pressure after a normally open valve, then braking termination, in order to operate a rear wheel brake, it is required to supply power to a reducing valve and to surely consider as a closed state. If possible, do not make it therefore, better for a rear wheel brake to operate on power reduction.

(5) It is the hydraulic brake to which at least one side of said front-wheel brake and rear wheel brake operates by fluid pressure. The thing corresponding to a hydraulic brake among said front-wheel damping force control device and a rear wheel damping force control device Two or more pumps with which drive power differs mutually are included. Said electric power supply control unit By actuation of said brakes operation member The alternative pump mechanical component which determines what supplies drive power among said two or more pumps at least based on one side of the magnitude of damping force and the increase inclination which are demanded is included. ** [there is no (1) term] Brake system of any one publication of the (4) terms (claim 3). For example, if possible, capacity is full and a small number of pump is operated, and power consumption is [direction] small and it ends in many cases rather than it operates two or more pumps in the condition that allowances are in regurgitation capacity, respectively. Moreover, when two or more pumps are with a low voltage pump and high pressure pumping, generally the amount of the maximum discharge flow is made small for the direction of high pressure pumping, and drive power is small and ends in many cases. Then, if the demand boost inclination decided by the actuation condition of a brakes operation member is small, even if demand fluid pressure is small, high pressure pumping is operated, and power consumption will be [direction] small and it will end. An alternative pump mechanical component has what supplies drive power among two or more pumps determined according to the regulation beforehand set up, for example based on these situations.

(6) It is the hydraulic brake to which at least one side of said front-wheel brake and rear wheel brake operates by fluid pressure. The thing corresponding to a hydraulic brake among said front-wheel damping force control device and a rear wheel damping force control device The opening controllable boost valve which permits that brake fluid flows into a hydraulic brake by the flow rate according to opening is included. It compares, when the increase inclination of the damping force as which said electric power supply control device is required by actuation of said brakes operation member is small and it is large. The power control section corresponding to the damping force inclination which makes small the supply voltage to said opening controllable boost valve is included. ** [there is no (1) term] Brake system of any one publication of the (5) terms. When it is necessary to increase the fluid pressure of a hydraulic brake, it is possible to make an opening controllable boost valve full open, and to also make brake fluid flow into a hydraulic brake, but when the increase inclination of the damping force demanded is small, if an opening controllable boost valve is made to open by small opening, it is enough, then the supply voltage to an opening controllable boost valve is small, and ends.

(7) It is the hydraulic brake to which at least one side of said front-wheel brake and rear wheel brake operates by fluid pressure. Pumping plant adjustable [thing / corresponding to a hydraulic brake among said front-wheel damping force control device and rear wheel damping force control devices] in the amount of discharge flow, The boost control valve equipment which controls a boost of a hydraulic brake by controlling the inflow to said hydraulic brake of the brake fluid breathed out from the pumping plant is included. Said electric power supply control unit The power allocation control section which controls allocation of the supply voltage to pumping plant and boost control valve equipment so that the sum of the supply voltage to said pumping plant and boost control valve equipment becomes small is included. ** [there is no (1) term] Brake system of any one publication of the (6) terms (claim 4). The amount of discharge flow can control fluid pressure increase of a hydraulic brake also by control of pumping plant also by control of boost control valve equipment in the brake system containing adjustable pumping plant and boost control valve equipment. And it is desirable to control allocation of the supply voltage to pumping plant and boost control valve equipment also to control of pumping plant or control of boost control valve equipment, so that the sum of power required for these control becomes as small as possible on power reduction since power is required. For example, the exciting current to the solenoid of the electromagnetic-control valve for a boost which constitutes boost control valve equipment is enlarged. The exciting current to the solenoid of the electromagnetic-control valve for a boost is made small rather than it makes the electromagnetic-control valve for a boost full open and makes the supply current to pumping plant small. Small power can attain a the same [a boost / enlarge / instead / make opening of the electromagnetic-control valve for a boost into necessary minimum, and / the supply current to pumping plant] rate in many cases.

(8) Operate with a brakes operation member, at least one brake, and power. In the brake system which contains two or more damping force control devices which control the damping force of said at least one brake according to actuation of said brakes operation member In within the limits from which the braking effects demanded by actuation of said brakes operation member are obtained The brake system characterized by

forming the electric power supply control unit which controls the electric power supply to two or more damping force control units so that the sum of the supply voltage to said two or more damping force control units becomes small (claim 5). To each of at least one brake, every, it may be prepared and two or more two or more one damping force control device may be formed at a time corresponding to each of two or more brakes. A former example In (7) terms, it is the mode of a publication and a latter example It is a mode given in (2) terms. In this brake system, power consumption is reduced by controlling the electric power supply to two or more damping force control units by the electric power supply control unit.
[0004]
[Embodiment of the Invention] The fluid pressure brake system which is 1 operation gestalt of this invention is explained based on drawing 1 thru/or drawing 5 . In drawing 1 , signs 10 and 12 show a forward left ring and a forward right ring, respectively, and signs 14 and 16 show a left rear ring and a right rear ring, respectively. The hydraulic brake equipped with the front wheel cylinders (a wheel cylinder is written as W/C if needed) 20 and 22 as a brake cylinder is prepared in front wheels 10 and 12 as a front-wheel brake, it operates by supplying fluid pressure to front W/C 20 and 22, and damping torque is applied to front wheels 10 and 12. The hydraulic brake equipped with rear W/C 24 and 26 as a brake cylinder is prepared as a rear wheel brake also like rear wheels 14 and 16. The fluid pressure of the source 30 of manual fluid pressure and the fluid pressure of the source 32 of power fluid pressure are alternatively supplied to front W/C 20 and 22, and the fluid pressure of the source 32 of power fluid pressure is surely supplied to rear W/C 24 and 26.
[0005] The source 30 of manual fluid pressure is equipped with the master cylinder (it is written as M/C if needed) 38 which generates the fluid pressure corresponding to the operating physical force (treading strength is called) of the brake pedal 36 as a brakes operation member. M/C38 is a tandem type and generates the fluid pressure of the same magnitude as two independent pressurized rooms. The master reservoir 39 is formed in M/C38. In the condition that a brake pedal 36 is in brake a non-acting location, and the pressurization piston in M/C38 is in retreat end position, if two pressurized rooms of M/C38 are open for free passage with the master reservoir 39 and a pressurization piston is slightly advanced from retreat end position, a pressurized room will be intercepted from the master reservoir 39. The pressurized room of front W/C20 and another side is connected to front W/C22 for one pressurized room by the liquid path 40 by the liquid path 42. electromagnetism respectively normally open to the liquid paths 40 and 42 -- the master cylinder cut valves (M/C cut valve) 44 and 46 which consist of a closing motion valve are formed, from these M/C cut valves 44 and 46, the fluid pressure by the side of front W/C20 and 22 is detected by the W/C fluid pressure sensors 50 and 52, and the fluid pressure by the side of M/C38 is detected by the M/C fluid pressure sensor 54.
[0006] While the stroke simulator 55 is arranged between a brake pedal 36 and M/C38, the stroke simulator 56 is connected also to the part by the side of M/C38 from the M/C cut valve 46 of the liquid path 42, and the treading-in stroke of a brake pedal 36 is detected by the stroke sensor 58. The above-mentioned stroke simulator 55 is equipped with elastic members, such as a spring. It is what that permits relative displacement of the specified quantity to M/C38 of a brake pedal 36 by the elastic deformation of an elastic member with. The stroke simulator 56 [like a pure machine] By holding a working fluid, increasing fluid pressure, where the M/C cut valves 44 and 46 are closed, permit discharge of the working fluid from M/C38, and two stroke simulators 55 and 56 work together. The feel similar to the brakes operation in the usual fluid pressure brake gear which does not have the source 32 of power fluid pressure is given to an operator.
[0007] The source 32 of power fluid pressure is equipped with the low voltage pump 64 and high pressure pumping 66 which are driven with electric motors 60 and 62, respectively. Both the low voltage pump 64 and high pressure pumping 66 are used as the gear pump, and let high pressure pumping 66 be what has the small amount of the maximum discharge flow more highly [the maximum regurgitation fluid pressure] than the low voltage pump 64. Therefore, in order to generate the same fluid pressure, from the low voltage pump 64, the direction of high pressure pumping 66 has small drive power, and ends.
[0008] It is each discharge side of the low voltage pump 64 and high pressure pumping 66, and check valves 68 and 70 are formed in the low voltage pump 64 and high-pressure-pumping 66 side, respectively rather than the part which the liquid path which supplies the working fluid breathed out from the low voltage pump 64 to W/C 20-26, and the liquid path which supplies the working fluid breathed out from high pressure pumping 66 to W/C 20-26 join. A check valve 68 prevents that the high regurgitation fluid pressure of high pressure pumping 66 acts on the low voltage pump 64 at the time of actuation of high pressure pumping 66, prevents that a working fluid leaks from the low voltage pump 64 which is a gear pump, and plays the role which prevents that the low

voltage pump 64 is reversed by the high-pressure working fluid breathed out from high pressure pumping 66. In order to prevent that the low voltage pump 64 is reversed by the high-pressure working fluid breathed out from high pressure pumping 66, and a working fluid returns to the master reservoir 39, it is what does not need to add maintenance torque to an electric motor 60. Moreover, high pressure pumping 66 is rotated by hard flow based on the regurgitation fluid pressure of the low voltage pump 64, and a check valve 70 prevents that a working fluid returns to the master reservoir 39, in case only the low voltage pump 64 operates, while preventing that a working fluid leaks from the high pressure pumping 66 which is a gear pump. Even if it does not add maintenance torque to the electric motor 62 which it is at the actuation time of the low voltage pump 64, and drives high pressure pumping 66 at the time of un-operating [of high pressure pumping 66], the inverse rotation of high pressure pumping 66 can be prevented.

[0009] The fluid pressure of the source 32 of power fluid pressure is supplied to W/C 20-26 by the liquid path 72, and is detected by the pump fluid pressure sensor 74. In addition, although illustration is omitted, the relief valve which makes relief ** the maximum regurgitation fluid pressure planned at it is prepared in the source 32 of power fluid pressure to high pressure pumping 66. Said check valve 70 also achieves the function to prevent that brake fluid leaks to the master reservoir 39, when this relief valve will not close by biting a foreign matter etc. In this operation gestalt, the source 32 of power fluid pressure is constituted by the pumping plant which consists of electric motors 60 and 62, the low voltage pump 64, high pressure pumping 66 and check valves 68 and 70, and the relief valve that is not illustrated so that clearly from the above explanation. The regurgitation fluid pressure of pumping plant is the fluid pressure of the source 32 of power fluid pressure, and the pump fluid pressure sensor 74 which detects the regurgitation fluid pressure of pumping plant constitutes the source fluid pressure detection equipment of power fluid pressure. It is PP about the regurgitation fluid pressure of pumping plant. Although expressed, it is this regurgitation fluid pressure PP. It is also the fluid pressure of the source 32 of power fluid pressure. In addition, when at least one side of the low voltage pump 64 and high pressure pumping 66 is equipped with discharge valves, such as a plunger pump, at least one side of check valves 68 and 70 may be omitted.

[0010] Respectively corresponding to front W/C 20 and 22, the electromagnetic-control valve 76 for a boost, the electromagnetic-control valve 78 for reduced pressure and the electromagnetic-control valve 80 for a boost, and the electromagnetic-control valve 82 for reduced pressure are formed. These have the structure roughly shown in drawing 2 , and are both normally closed seating valves. Corresponding to rear W/C 24 and 26, the electromagnetic-control valve 84 for a boost, the electromagnetic-control valve 86 for reduced pressure and the electromagnetic-control valve 88 for a boost, and the electromagnetic-control valve 90 for reduced pressure are formed. Although the electromagnetic-control valves 84 and 88 for a boost are normally closed seating valves as shown in drawing 3 , the electromagnetic-control valves 86 and 90 for reduced pressure are normally open seating valves. Such structures are explained in full detail behind. The fluid pressure of rear W/C 24 and 26 is detected by the W/C fluid pressure sensors 92 and 94, respectively.

[0011] The front wheel 10, said electromagnetic-control valve 76 for a boost by the side of 12, and the electromagnetic-control valve 78 for reduced pressure have the structure roughly shown in drawing 2 . The electromagnetic-control valve 76 for a boost is equipped with the seating valve 134 which consists of the valve 132 which can be sat down and estranged to a valve seat 130 and it, and the valve 132 is energized in the taking-a-seat direction with the spring 136 as energization equipment. The movable core 138 is formed in one with the valve 132, this is countered and the fixed core 140 is formed. Although made to estrange both [these] the cores 138,140 of each other with the above-mentioned spring 136, it is magnetized by supplying a current to a coil 142, and the movable core 138 is attracted at the fixed core 140 side. Thereby, a valve 132 is made to estrange from a valve seat 130, and a seating valve 134 is opened. The electromagnetic-control valve 76 for a boost is connected to the source 32 of power fluid pressure, and front W/C20 with the sense which acts on the sense which the fluid pressure difference before and behind itself makes estrange a valve 132 from a valve seat 130. therefore, the electromagnetism of the solenoid 144 to which a valve 132 changes from the differential pressure applied force based on a fluid pressure difference, the movable core 138 and the fixed core 140, and coil 142 before and behind a seating valve 134 -- the electromagnetism the sum with driving force will stop in the location which balances with the energization force of a spring 136, and according to control of the supply current to a coil 142 -- the opening of a seating valve 134 is controllable by control of driving force. The opening of the electromagnetic-control valve 76 for a boost can be controlled, and the flow rate of a working fluid, i.e., the boost inclination of front W/C20, (namely, boost rate) can be controlled by it.

moreover, the difference of the fluid pressure of the source 32 of power fluid pressure, and the fluid pressure of front W/C20 -- small -- becoming -- differential pressure applied force and electromagnetism -- if the sum with driving force becomes small slightly from the energization force of a spring 136, since a valve 132 will sit down to a valve seat 130 and a seating valve 134 will close, the difference of the fluid pressure of the source 32 of power fluid pressure and the fluid pressure of front W/C20 is controllable by control of the supply current to a coil 142.
[0012] Since the structure of the electromagnetic-control valve 78 for reduced pressure is the same as the electromagnetic-control valve 76 for a boost, it shows the component which corresponds mutually with the same sign, and omits explanation. However, the differential pressure applied force based on the difference of the fluid pressure of front W/C20 and the fluid pressure of the master reservoir 39 is the sense which acts on the sense which makes a valve 132 estrange from a valve seat 130, and the electromagnetic-control valve 78 for reduced pressure is connected to front W/C20 and the master reservoir 39 by the liquid path 40 and the liquid path 146. Therefore, the reduced pressure rate of front W/C20 and the differential pressure of front W/C20 and the master reservoir 39 are controllable by control of the supply current to a coil 142. Since the fluid pressure of the master reservoir 39 can regard it as an atmospheric pressure substantially, control of the differential pressure of front W/C20 and the master reservoir 39 turns into fluid pressure control of front W/C20 as it is.
[0013] Since rear W/C24 and the electromagnetic-control valves 84 and 88 for a boost by the side of 26 are the same as above-mentioned front W/C20 and the electromagnetic-control valves 76 and 80 for a boost by the side of 22, in drawing 3 , they show the component which corresponds mutually with the same sign, and omit explanation. To it, the electromagnetic-control valves 86 and 90 for reduced pressure are normally open seating valves, and structures differ a little. The valve 130 is energized by the sense estranged from a valve seat 130 with a spring 150 although it is the same to have the seating valve 134 which consists of a valve seat 130 and a valve 132. The seating valve 134 is arranged with the sense which acts on the sense which the differential pressure applied force based on the differential pressure of rear W/C24 and the master reservoir 39 makes estrange a valve 132 from a valve seat 130. It is prepared in one with the movable core 154 while the back end section of a valve 132 penetrated the through hole formed in the center of the fixed core 152, is prolonged and is made to project from the fixed core 152. if a current is supplied to a coil 156, the fixed core 152 and the movable core 154 will be magnetized, and the movable core 154 will be attracted at the fixed core 152 side -- a valve 132 -- electromagnetism -- driving force is given. the electromagnetism of the solenoid 158 which consists of the fixed core 152, the movable core 154, and a coil 156 -- driving force acts on the sense which the above-mentioned differential pressure applied force is resisted [sense], and sits a valve 132 to a valve seat 130. in addition, the energization force of a spring 150 -- differential pressure applied force -- electromagnetism -- in case keeping of the force which acts on a valve 132 is considered that what is necessary is just the magnitude which can maintain a valve 132 at the condition of having estranged from the valve seat 130, in the condition that driving force does not act, either, it does not ignore and interfere.
[0014] Each component explained above is connected to the control unit 170 shown in drawing 4 . The control unit 170 was equipped with the fluid pressure control computer 172, and this fluid pressure control computer 172 is equipped with PU (processing unit)174, ROM176, RAM178, and I/O Port 180. While various detectors including said stroke sensor 58 are connected, various actuators including said electric motor 60 are connected to I/O Port 180 through the drive circuit 184, respectively. The control unit 170 is constituted by these drive circuit 184 and the fluid pressure control computer 172. The wheel slip house keeping computer 186 is connected to I/O Port 180, and the usual fluid pressure control routine expressed with the flow chart of drawing 5 with other control programs including the main routine which omits illustration and explanation is stored in ROM176. While PU174 usually performs a fluid pressure control routine using RAM178 based on the information from various detectors including the stroke sensor 58 and controlling the fluid pressure of W/C 20-26 The antilock control which is based on information etc. from the wheel slip house keeping computer 186, and prevents an excessive slip of the wheel at the time of braking, In order to secure the driving stability of the traction control and the car which prevent an excessive slip of the wheel at the time of acceleration, vehicle stability control which operates a fluid pressure brake system is performed. In addition, if it adds, it is also possible to constitute the fluid pressure control computer 172 and the wheel slip house keeping computer 186 from one computer. For example, a wheel slip house keeping program is also stored in the above-mentioned main routine and ROM of the computer which usually executes control programs, such as a fluid

pressure control routine, and it is made to perform by time sharing.

[0015] Since the above-mentioned antilock control, traction control, vehicle stability control, etc. do not have the need when you understand this invention, explanation is omitted, and fluid pressure control of W/C 20-26 by activation of a fluid pressure control routine is usually explained hereafter. Usually, a fluid pressure control routine is performed once for every regularity minute time amount like [for every 5msec(s)]. First, the step 1 (it is indicated as the following S1.) other steps -- being the same -- it sets and the desired value of W/C fluid pressure calculates. In principle, it is carried out so that it may be proportional to the M/C fluid pressure (it corresponds to the treading strength of a brake pedal 36) by which the desired value of W/C fluid pressure is detected by the M/C fluid pressure sensor 54, but this operation is performed by taking into consideration the treading-in stroke of the brake pedal 36 detected by the stroke sensor 58, in order that the rise of M/C fluid pressure may be overdue to treading-in actuation of a brake pedal 36. In this operation gestalt, the target W/C fluid pressure PWCNM which is the desired value of W/C fluid pressure is determined that the relation of PWCNM=gamma (t) and PMC+delta (t) -S is realized between the M/C fluid pressure PMC and the treading-in stroke S. In here, multiplier gamma (t) becomes so large that the elapsed time t from treading-in initiation of a brake pedal 36 increases, and multiplier delta (t) becomes so small that elapsed time t increases. However, generally not only the above-mentioned formula but based on the function of PWCNM=f (t, S, PMC), it can be determined.

[0016] In S1, as mentioned above, although the target W/C fluid pressure PWCNM according to the actuation condition of a brake pedal 36 calculates Like the after-mentioned, when this fluid pressure brake system has the small treading strength (M/C fluid pressure PMC) of a brake pedal 36 and the deceleration demanded is small When only a front-wheel brake is operated and big deceleration is demanded Since it is constituted so that both a front-wheel brake and a rear wheel brake may be operated, when the operation of the target W/C fluid pressure PWCNM is operated only with a front-wheel brake When it is carried out so that demand deceleration may be attained by only the front-wheel brake, and both a front-wheel brake and a rear wheel brake are operated, it is carried out so that demand deceleration may be attained by both brakes. Therefore, the actuation mode flag showing whether it is in the condition that only a front-wheel brake is operated, or it is in the condition that both a front-wheel brake and a rear wheel brake are operated is formed in RAM178. While being set as "0" which expresses that it is in the condition that only a front-wheel brake is operated in initial setting of the main routine which this actuation mode flag does not illustrate When the below-mentioned judgment result of S7 is YES, it is set as "1" showing being in the condition that both a front-wheel brake and a rear wheel brake are operated, and in NO, it is returned "0." In S1, the operation of the target W/C fluid pressure PWCNM is performed based on whether the value of this actuation mode flag is "0", or it is "1." Since the treading strength of a brake pedal 36 is surely small at the beginning of treading-in initiation, if actuation of a front-wheel brake is started first and treading strength exceeds setting treading strength after that, actuation of a rear wheel brake will also be started. In this case, in S1, the target W/C fluid pressure PWCNM will calculate so that demand deceleration may be attained only in a front-wheel brake at the beginning, and behind, the target W/C fluid pressure PWCNM will calculate so that demand deceleration may be attained in both a front-wheel brake and a rear wheel brake. And when treading strength exceeds setting treading strength, the target W/C fluid pressure PWCNM of front W/C 20 and 22 is made to decrease rapidly in this operation gestalt, since it is controlled so that the fluid pressure of front W/C 20 and 22 and the fluid pressure of rear W/C 24 and 26 become equal substantially when both a front-wheel brake and a rear wheel brake are operated. however, the deceleration acquired by the rear wheel brake is more considerable than the deceleration acquired by the front-wheel brake -- it is small, and since control delay has arisen in the fluid pressure of front W/C 20 and 22 when it gets into a brake pedal 36 at the rate of about 1 law and treading strength exceeds setting treading strength, it usually comes out of change of the actual deceleration resulting from rapid decrease of the target W/C fluid pressure PWCNM of above-mentioned front W/C 20 and 22 not to become so large that sense of incongruity given to an operator.

[0017] In S2, the deflection to the above-mentioned target W/C fluid pressure PWCNM of real W / C fluid pressure PWCAC which is actual W/C fluid pressure calculates. Usually, although real W / C fluid pressure PWCAC of W/C 20-26 must originally be mutually equal when only a front-wheel brake is operated at the time of braking and real W / C fluid pressure PWCAC, front-wheel brake, and rear wheel brake of front W/C20 and 22 comrades are operated [both], in real W / C fluid pressure PWCAC of W/C 20-26, minute dispersion arises in fact according to the individual difference of the electromagnetic-control valve 76 grade for a boost.

Therefore, in S2, the deflection to the target W/C fluid pressure PWCNM of real W / C fluid pressure PWCAC of all W/C 20-26 is called for. And in S3, it is judged whether real W / C fluid pressure PWCAC of whether it is that for which either of the above-mentioned deflection needs increase of W/C fluid pressure, and one of W/C are smaller than the target W/C fluid pressure PWCNM. When the result of a judgment is judged as there being the need for a boost in YES, i.e., W/C of one or more flowers, it is judged in S4 whether demand boost inclination is large. That is, the judgment with the larger demand boost inclination which is the difference which deducted the target W/C fluid pressure PWCNM calculated last time from the target W/C fluid pressure PWCNM calculated in S1 this time than setting boost inclination (set as a value which is different by the case where both the case where only a front-wheel brake is operated, and a front-wheel brake and a rear wheel brake are operated) is performed.
[0018] When the result of NO, i.e., demand boost inclination, of a judgment is small, operation of high pressure pumping 66 is performed in S5. The current which was suitable for the electric motor 62 which drives high pressure pumping 66 attaining said target W/C fluid pressure PWCNM and the above-mentioned demand boost inclination is supplied, and high pressure pumping 66 drives with suitable driving force. In addition, the relation between the supply current to an electric motor 62, and the regurgitation fluid pressure and the boost inclination which are realized by high pressure pumping 66 is beforehand investigated by experiment, and is table-ized, it is stored in ROM176, and the supply current to an electric motor 62 is controlled by the feedforward control based on this pump-performance table, and feedback control based on the detection result of the pump fluid pressure sensor 74. Then, operation of the low voltage pump 64 is suspended in S6. The supply current to an electric motor 60 is stopped, when the low voltage pump 64 is operated till then by it, it is stopped by it, and it is made to continue stopping when not operated.
[0019] Then, in S7, it is judged by whether the M/C fluid pressure detected by the M/C fluid pressure sensor 54 is larger than setting M/C fluid pressure whether the treading strength of a brake pedal 36 is larger than setting treading strength. Setting M/C fluid pressure is set as the fluid pressure of the limitation which can be generated only in a front-wheel brake in the deceleration corresponding to it, if the judgment result of S7 is YES, it will be set as "1" which means that an actuation mode flag is operated with both a front-wheel brake and a rear wheel brake as mentioned above in S8, and the opening of the electromagnetic-control valves 84 and 88 for a boost corresponding to rear W/C 24 and 26 will be determined in S9. The opening suitable for attaining said demand boost inclination is determined, and the current corresponding to the opening is supplied to the solenoid 144 of the electromagnetic-control valves 84 and 88 for a boost. In addition, although not only the supply current to a solenoid 144 but the actual opening of the electromagnetic-control valves 84 and 88 for a boost is influenced of the fluid pressure difference before and behind the electromagnetic-control valves 84 and 88 for a boost, the current supplied here is a current from which the opening by which a decision was made [above-mentioned] is obtained, when the fluid pressure difference before and behind the electromagnetic-control valves 84 and 88 for a boost is assumed to be 0. Brake fluid is supplied to rear W/C 24 and 26 by supply of this current, and a rear wheel brake is operated. Moreover, in S10, the opening of the electromagnetic-control valves 76 and 80 for a boost corresponding to front W/C 20 and 22 is determined, the current corresponding to the opening is supplied to a solenoid 144, and a front-wheel brake is operated. Decision of the opening of the electromagnetic-control valves 76 and 80 for a boost and supply of the current to a solenoid 144 are performed like the case of a rear wheel brake.
[0020] Thus, although both a rear wheel brake and a front-wheel brake are operated when the treading strength of a brake pedal 36 is larger than setting treading strength When the treading strength of a brake pedal 36 is smaller than setting treading strength, the judgment result of S7 serves as NO, and it sets to S11. It is set as "0" showing an actuation mode flag being operated only with a front-wheel brake, and the electromagnetic-control valves 84 and 88 for a boost corresponding to rear W/C 24 and 26 are closed in S12. Then, since the electromagnetic-control valves 84 and 88 for a boost are closed as mentioned above, a rear wheel brake is not operated but only a front-wheel brake is made to operate with it, although a front-wheel brake is operated in S10.
[0021] When the judgment result of said S4 is YES (i.e., when demand boost inclination is large), the low voltage pump 64 is operated in S13. By operation of the low voltage pump 64, although operation of this low voltage pump 64 as well as operation of said high pressure pumping 66 is performed, when insufficient (i.e., when the realized boost inclination is smaller than demand boost inclination), or when target W/C fluid pressure is larger than the maximum regurgitation fluid pressure of the low voltage pump 64, the judgment of

S14 serves as YES and operation of high pressure pumping 66 is performed in S15. Both the low voltage pump 64 and the high pressure pumping 66 are operated, and it is made to be obtained in big boost inclination or big regurgitation fluid pressure. However, if the judgment of S14 is performed immediately after starting operation of the low voltage pump 64 in S13, since the low voltage pump 64 has not yet reached a steady operation condition, the judgment of S14 will surely be set to YES, and operation of high pressure pumping 66 will be started. Therefore, the judgment of S14 is performed only after time amount sufficient after operation of the low voltage pump 64 is started in S13 to be in a steady operation condition passes, and it is surely made to shift to S16 before it. Operation of high pressure pumping 66 is stopped in S16. When demand boost inclination and demand fluid pressure are filled with operation of only the low voltage pump 64, high pressure pumping 66 is not operated.
[0022] moreover, when said judgment result of S3 does not have the need for a boost in any of NO 20 and 22, i.e., front W/C, and rear W/C 24 and 26 Although operated among high pressure pumping 66 and the low voltage pump 64 at the time, in S17 the current of electric motors 60 and 62 The fluid pressure detected by the pump fluid pressure sensor 74 is controlled so that only the constant rate defined beforehand serves as high fluid pressure from the target W/C fluid pressure PWCNM at the time. Then, in S18, all the electromagnetic-control valves 76, 80, 84, and 88 for a boost are closed, in S19, the thing among the electromagnetic-control valves 78, 82, 86, and 90 for reduced pressure to be decompressed is opened, and a thing to be held is closed. It is controlled by this control by the magnitude in which deceleration it is decided in the treading-in actuation situation of a brake pedal 36 that each fluid pressure of front W/C 20 and 22 and rear W/C 24 and 26 will be is realized, respectively.
[0023] Thus, in this fluid pressure brake system, when demand boost inclination is large, the large low voltage pump 64 of power consumption is operated, but since the small high pressure pumping 66 of power consumption is operated when demand boost inclination is small, the power which control of the source 32 of power fluid pressure constituted by pumping plant takes is as much as possible small, and ends. Moreover, since only a front-wheel brake is operated when demand deceleration is small although both a front-wheel brake and a rear wheel brake are operated when demand deceleration is large, as compared with the case where both a front-wheel brake and a rear wheel brake are always operated, the power which the object for a boost and the electromagnetic-control valve 76 for reduced pressure thru/or control of 90 take is small, and ends. Since especially the electromagnetic-control valves 86 and 90 for reduced pressure for rear wheel brakes are normally open valves, in order to operate a rear wheel brake, they need to continue supplying an exciting current to the solenoid 158 of the electromagnetic-control valves 86 and 90 for reduced pressure, its power consumption is large but, since a rear wheel brake is operated only when big deceleration is required especially, its power consumption is small and it ends. Furthermore, since the electromagnetic-control valves 76, 80, 84, and 88 for a boost are opened by the opening according to demand boost inclination, at the time of boost control, as compared with the case where it always considers as full open, its power for control is small at the time of boost control, and they end at it.
[0024] In this operation gestalt, the electromagnetic-control valves 76 and 80 for a boost and the electromagnetic-control valves 78 and 82 for reduced pressure constitute a front-wheel damping force control unit, the electromagnetic-control valves 84 and 88 for a boost and the electromagnetic-control valves 86 and 90 for reduced pressure constitute a rear wheel damping force control unit, and the part which performs 172 fluid pressure control computerS7 thru/or S12 constitutes the alternative power feed zone so that clearly from the above explanation. Moreover, the part into which the low voltage pump 64 and high pressure pumping 66 constitute two or more pumps with which drive power differs mutually, and perform S4 of the fluid pressure control computer 172 S6 and S13 thru/or S16 constitutes the alternative pump mechanical component. And the above-mentioned front-wheel damping force control unit and a rear wheel damping force control unit constitute a damping force control unit with the drive circuit 184 which drives electric motors 60 and 62 and them, and the above-mentioned alternative power feed zone and the alternative pump mechanical component constitute the electric power supply control unit.
[0025] Furthermore, the low voltage pump 64 and high pressure pumping 66 constitute pumping plant adjustable in the amount of discharge flow, the electromagnetic-control valves 76, 80, 84, and 88 for a boost constitute boost control valve equipment, and the part which performs the usual fluid pressure control routine of drawing 5 of the fluid pressure control computer 172 constitutes the power allocation control section. Moreover, pumping plant and boost control valve equipment adjustable in the above-mentioned amount of

discharge flow constitute two or more damping force control devices, and the part which performs the usual fluid pressure control routine of drawing 5 of the fluid pressure control computer 172 constitutes the electric power supply control device.
[0026] In addition, although a rear wheel brake is additionally operated when adding, and only a front-wheel brake is operated at the beginning and the treading strength of a brake pedal 36 becomes large from setting treading strength in the above-mentioned operation gestalt behind In that case, target W/C fluid pressure (target damping force) of a front-wheel brake which had realized demand deceleration independently is once made small, and demand deceleration is made to be together realized by being operated by the W/C fluid pressure with same front-wheel brake and rear wheel brake. However, it is also possible to maintain the damping force till then, for rear wheel damping force to be added simply, and for a front-wheel brake to be made to be enlarged gradually from 0. Enlarging rear wheel damping force gradually from 0 keeps constant the fluid pressure of the source 32 of power fluid pressure, and it can be realized by controlling the electromagnetic-control valves 84 and 88 for a boost.
[0027] Moreover, the cure with which the power which control of the source 32 of power fluid pressure constituted by pumping plant takes in the above-mentioned operation gestalt is as much as possible small with cure, and it is made to end, The cure with which power consumption is small with cure and it is made to end by making it only a front-wheel brake operated when demand deceleration is small, Although all of three with the cures with which power consumption is small with cures and it is made to end by making it not make the electromagnetic-control valves 76, 80, 84, and 88 for a boost open greatly superfluously at the time of boost control were devised Each of three cures is able to be independently devised to drawing 6 , drawing 7 , and drawing 8 by the control routine shown, respectively. Moreover, although illustration of a control routine is omitted, it is also possible for two of the arbitration of the three above-mentioned cures to put together and be made to carry out.
[0028] In the pumping plant control routine of drawing 6 , in S20, the treading-in stroke of a brake pedal 36 is read from the stroke sensor 58 (M/C fluid pressure may be read from the M/C fluid pressure sensor 54), and the judgment of being the need is performed for a boost by whether the treading-in stroke is increasing in S21. If the boost is required, in S22, the judgment with small demand boost inclination will be performed by whether the difference of the last treading-in stroke and this treading-in stroke is below the 1st setting difference, and if a judgment is YES, high pressure pumping 66 will be operated by S23. If a judgment is NO, in S24, by whether the difference of the last treading-in stroke and this treading-in stroke is below the larger 2nd setting difference than the 1st setting difference Although the judgment of whether demand boost inclination is whenever [middle] is performed, and the low voltage pump 64 will be operated in S25 if a judgment is YES If a judgment is NO, since I hear that demand boost inclination is large and there is, in S26, both high pressure pumping 66 and the low voltage pump 64 are operated. Moreover, in S27, it breaks in after activation of S25, and the judgment with a large treading-in stroke is performed by whether a stroke is beyond a setting stroke, if a judgment is YES, high pressure pumping 66 will be additionally operated by S28, and supply of high-pressure brake fluid will be enabled at W/C 20-26. If said judgment of S21 is NO, the regurgitation fluid pressure of the high pressure pumping 66 currently operated in S29 at the time and the low voltage pump 64 will be maintained.
[0029] In the drawing 7 order ring brake control routine, the treading strength of a brake pedal 36 is read in S31. Treading strength may be converted from the detection result of the M/C fluid pressure sensor 54, and may be read from the treading strength sensor attached in the brake pedal 36. Instead of treading strength, a stroke is able to be read from the stroke sensor 58. Then, in S32, demand deceleration calculates from the read treading strength (or stroke), and it is judged in S33 whether demand deceleration is larger than setting deceleration. When the result of a judgment is YES, both a front-wheel brake and a rear wheel brake are operated by S34, and when it is NO, only a front-wheel brake is operated by S35. A hydraulic brake is sufficient as both a front-wheel brake and a rear wheel brake, and at least one side may be used as a dynamo-electric brake.
[0030] In the electromagnetic-control valve-control routine of drawing 8 , the treading strength of a brake pedal 36 is read by S41, and it is judged whether a boost is required of S42. If a judgment is YES, in S43, the opening of the electromagnetic-control valves 76, 80, 84, and 88 for a boost will be determined based on the change rate of treading strength, and if a judgment is NO, it will be judged whether reduced pressure is required of S44. If a judgment is YES, in S45, the opening of the electromagnetic-control valves 78, 82, 86, and

90 for reduced pressure will be determined based on the change rate of treading strength, and if a judgment is NO, in S46, both the electromagnetic-control valves 76, 80, 84, and 88 for a boost and the electromagnetic-control valves 78, 82, 86, and 90 for reduced pressure will be closed. In this operation gestalt, although the object for a boost and the electromagnetic-control valves for reduced pressure are controlled all at once according to actuation of a brake pedal 36, it is also possible to make it respectively controlled independently based on the detection result of the M/C fluid pressure sensor 54 and the W/C fluid pressure sensors 50, 52, 92, and 94.
[0031] Moreover, although said operation gestalt is an example when this invention is applied to a fluid pressure brake system, this invention can also be applied to the brake system equipped with the dynamo-electric brake which operates with electric actuators, such as an electric motor, as well as applying to a fluid pressure brake system in modes other than this. The simplest example is a brake system by which only either of the electric actuator of a front-wheel brake and the electric actuator of a rear wheel brake is operated, and the electric actuator of both a front-wheel brake and a rear wheel brake is operated when demand deceleration is large, when demand deceleration is small.
[0032] In addition, although what is illustrated one by one is not done, this invention can be carried out in the mode which added various deformation and amelioration based on this contractor's knowledge, including the mode indicated by the term of the above [Object of the Invention, a technical-problem solution means, and effectiveness].

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram showing the fluid pressure brake system which is 1 operation gestalt of this invention.
[Drawing 2] In the above-mentioned fluid pressure brake system, it is the front view (part cross section) showing the electromagnetic-control valve for a boost and the electromagnetic-control valve for reduced pressure which were prepared about the front wheel.
[Drawing 3] In the above-mentioned fluid pressure brake system, it is the front view (part cross section) showing the electromagnetic-control valve for a boost and the electromagnetic-control valve for reduced pressure which were prepared about the rear wheel.
[Drawing 4] It is the block diagram showing the deep part of relation in this invention roughly among the control devices formed in the above-mentioned fluid pressure brake system.
[Drawing 5] It is the flowchart in which the usual fluid pressure control routine of the above-mentioned fluid pressure brake system is shown.
[Drawing 6] It is the flowchart in which the pumping plant control routine of the fluid pressure brake system which is another operation gestalt of this invention is shown.
[Drawing 7] It is the flowchart in which the fluid pressure brake system order ring brake control routine which is still more nearly another operation gestalt of this invention is shown.
[Drawing 8] It is the flowchart in which the electromagnetic-control valve-control routine of the fluid pressure brake system which is still more nearly another operation gestalt of this invention is shown.

[Description of Notations]
10: Forward left ring 12: Forward right ring 14: Left rear ring 16: Right rear ring 20 22: Front wheel cylinder 24 26: Rear wheel cylinder 36: Brake pedal 50, 52, 90, 92: Wheel-cylinder fluid pressure sensor
54: Master cylinder fluid pressure sensor 58: Stroke sensor 60 62: Electric motor 64: Low voltage pump 66: High pressure pumping 74: Pump fluid pressure sensor 76, 80, 84, 88: Electromagnetic-control valve for a boost 78, 82, 86, 90: Electromagnetic-control valve for reduced pressure 170: Control unit 172: Fluid pressure control computer